# Description of the Hitherto Unknown Adult and Pupa of *Culex (Melanoconion) simulator* Dyar and Knab, and Redescription of its Larva (Diptera: Culicidae)[1]

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**ABSTRACT.** The hitherto unknown adult and pupa of *Culex (Melanoconion) simulator* Dyar and Knab 1906 from near the type-locality in Trinidad are described, and an additional description of the larva is given. The male genitalia, female cibarial armature, and chaetotaxy of the pupa and larva are figured. A new record of this species from Panama is noted. Characters are given to separate *simulator* from the closely related *jubifer* Komp and Brown 1935.

## INTRODUCTION

Of all the collections of *Culex (Melanoconion)* from Central and South America (including the West Indies) that have been made, that of the project "Mosquitoes of Middle America" (MOMA) is the most outstanding in terms of the quantity and quality of the specimens (especially of the associated reared material). This collection was made by Dr. John N. Belkin, and his staff and collaborators from 1963 to the present. The major portion of the *Melanoconion* material from the MOMA collection was transfered to the Smithsonian Institution in June 1976 for taxonomic study by the Medical Entomology Project (MEP). The junior author has curated this collection, provisionally identifying a considerable number of specimens of more than 80 species. In addition, there were almost 30 species that could not be readily identified on the basis of the existing literature. These undetermined specimens were assigned species numbers, or were distinguished by an indication of the most closely related species.

Among this indefinitely identified material, there is an interesting series of reared specimens from T. H. G. Aitken's collection in Trinidad, which was identified by the junior author as "sp. nr. *jubifer.*" In addition, there is another series of reared specimens from Panama, which bear the same identification label. Recently, the senior author re-examined these specimens and compared them in considerable detail with the existing types of practically all species originally and subsequently described by Dyar and several other American workers in the collection of the U. S. National Museum (USNM). Furthermore, an extensive comparison of the associated larvae with the type-larvae at the USNM and those of several other species in the entire collection has been made. This study has concluded that the "sp. nr. *jubifer*" specimens belong to *Culex simulator* Dyar and Knab 1906. In the original description, *simulator* was described from a larva collected in Trinidad, and ever since has been known only in this stage, as subsequently described and figured by Howard, Dyar and Knab (1913:fig. 352; 1915: 302), Dyar (1928:333, fig. 287) and Foote (1954:89). We take this opportunity to now describe and illustrate all stages of *simulator,* so that it can be readily recognized and separated from other species of *Melanoconion.* In particular, we include characters to separate *simulator* from *jubifer* Komp and Brown 1935, its most closely related species.

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[1] This work was supported in part by U. S. Army Medical Research and Development Command Research Contract DAMD-17-74-C-4086; and in part by U. S. Public Health Service Research Grant AI-04379 and U. S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478.

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# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **1980** | | **00-00-1980 to 00-00-1980** |

| 4. TITLE AND SUBTITLE | 5a. CONTRACT NUMBER |
|---|---|
| **Description of the Hitherto Unknown Adult and Pupa of Culex (Melanoconion) simulator Dyar and Knab, and Redescription of its Larva (Diptera: Culicidae)** | 5b. GRANT NUMBER |
| | 5c. PROGRAM ELEMENT NUMBER |
| 6. AUTHOR(S) | 5d. PROJECT NUMBER |
| | 5e. TASK NUMBER |
| | 5f. WORK UNIT NUMBER |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Smithsonian Institution,Medical Entomology Project,Washington,DC,20560** | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | 10. SPONSOR/MONITOR'S ACRONYM(S) |
| | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) |

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release; distribution unlimited**

13. SUPPLEMENTARY NOTES

14. ABSTRACT
**see report**

15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | |
| **unclassified** | **unclassified** | **unclassified** | **Same as Report (SAR)** | **9** | |

## *Culex (Melanoconion) simulator* Dyar and Knab
(Figs. 1, 2, 3)

1906. *Culex simulator* Dyar and Knab 1906:218. TYPE. Lectotype: 4th instar larva (47), Arima (St. George), TRINIDAD, 10 July 1905, A. Busck (USNM; selection of Stone and Knight 1957:56).

*Culex simulator* of Howard, Dyar and Knab (1913:fig. 352; 1915:302).

*Culex (?Mochlostyrax) simulator* of Dyar (1928:333).

*Culex (Melanoconion) simulator* of Edwards (1932:217); Foote (1954:89); Stone, Knight and Starcke (1959:275); Belkin, Schick and Heinemann (1965:70); Knight and Stone (1977:264).

**FEMALE.** Wing: 3.2 mm. Forefemur: 1.7 mm. Proboscis: 1.7 mm. Abdomen: 2.4 mm. In general, medium sized, brownish species without any distinctive coloration on palpus, proboscis, thorax, legs or abdomen. **Head.** Decumbent scales in broad central area of vertex narrow, linear or crescent-shaped, white on anterior orbital margin, predominantly dark posteriorly; decumbent broad scales restricted to sides of eyes, forming a distinct lateral white patch; erect scales numerous, long, entirely dark; frontal and upper orbital bristles strong, entirely dark. Palpus dark scaled, 0.2 of proboscis length. Proboscis dark scaled, uniformly thick, about as long as forefemur; labial basal setae 4, about 0.5 of palpal length. Antenna slightly longer than proboscis; torus pale except for dark mesal spot, and with a few, fine, short, mesal setae; flagellar whorls poorly developed. **Thorax.** Mesonotal integument medium to dark brown; scales narrow, numerous, medium to dark brown on disc, prescutellar space and scutellar lobes; acrostichal bristles not developed except for a few on anterior promontory; dorsocentral bristles strong. Pronotum slightly paler than mesonotum; *apn* with 1,2 strong bristles and 4-7 weaker setae on dorsolateral surface; *ppn* with 2-5 strong posterior bristles and 2-5 other short and weak setae cephalad; anterior upper surface with some scattered brownish narrow scales. Pleural integument very pale, contrasting rather sharply with color of mesonotum; scale patches entirely absent on all sclerites; *ppl* with 3 strong setae and few other weak setae; upper corner of *stp* with 4,5 strong setae, widely spaced, followed by one strong seta and 4,5 weak setae along lower posterior border; lower *mep* bristle 1, upper *mep* bristle 8,9. **Legs.** All tarsi dark; anterior surface of hindfemur with distinct pale stripe extending from base to near apex. **Wing.** All scales dark and dense on all veins; plume scales in distal part of $R_2$, $R_3$, $R_{4+5}$, branches of M and Cu narrow, clavate. **Abdomen.** All tergites dark scaled, no basolateral pale spots; sternites pale. **Cibarial Armature** (Fig. 2). Cibarial bar moderately broad, with a row of 16-20 flat, apically blunt teeth; teeth pigmented on axis, pale distally; median tooth shortest, lateral ones progressively longer.

**MALE.** As described for female except for the following. **Head.** Narrow decumbent scales of vertex entirely whitish. Palpus slender, long, exceeding proboscis by 1.5-2.0 of length of segment 5; segment 3 with 2,3 apical bristles; segments 4,5 very weakly plumose. Proboscis with labial false joint at 0.7 of the length from base. Antenna slightly shorter than proboscis, flagellum strongly plumose.

**MALE GENITALIA** (Fig. 1). **Segment VIII.** Tergite with median caudal margin shallowly emarginate, with an irregular row of about 10-12 strong setae; weaker setae scattered on caudal half of tergite; a narrow irregular band of more than 20 scales present cephalad of setae. **Segment IX.** Tergite lobes well developed, hollow and balloonlike, formed by evagination of tergite, with narrow slitlike opening on inner surface of tergite; lobes large, appearing roughly oval in dorsal aspect, diagonally oriented such that anterior ends of oval are closer together than posterior ends; dorsal surface of lobe bearing about 20 posteriorly directed, short setae; setae tending to be absent on anterior ends of lobe; posterior end and stem of lobe tending to be rugose. **Sidepiece.** In lateral aspect, appearing roughly oval, length 0.26 mm, greatest width 0.15 mm; basal outer tergal surface with or without a few short narrow scales; distal lateral tergal surface with large dense patch of numerous strong setae extending from level of proximal division of subapical lobe to apex of sidepiece, lateral setae very long, subequal to length of sidepiece, more dorsal setae progressively shorter; rest of sur-

face of sidepiece with scattered, mostly shorter setae. **Subapical Lobe.** Divided into strongly divergent, dorsally projecting proximal and distal divisions, each division consisting of columnar process bearing variously modified setae. Proximal division bearing 2 long, straight, parallel, rodlike setae (*a, b*); seta *a* inserted subapically; seta *b* inserted apically, equal in length to *a* and about 1.5 length of column; in lateral aspect, apexes of *a,b* appearing rounded with very small hook. Distal division with large, stemed, fan-shaped, striated leaflet inserted on small tubercle just distad and laterad of base of column; column bearing following setae: (1) a long rodlike seta about equal to length of seta *a,* with subapex slightly enlarged, and apex pointed, attenuate and recurved, inserted subapically on lateral surface of column, (2) a shorter, apically hooked, rodlike seta about 0.7 length of seta *a,* inserted apically, (3) a short, hairlike seta slightly more than 0.4 length of seta *a,* inserted at base of preceeding seta, (4) a long, broad, flattened, slightly sinuate seta with rounded hyaline apex, about 0.8 length of seta *a,* inserted subapically, (5) a long, hyaline seta with apex rounded and with small hook, about 0.8 length of seta *a,* inserted medially on mesal surface, (6) a slightly shorter, apically rounded, hyaline seta about 0.7 length of seta *a,* inserted medially on mesal surface of column (possibly 2 setae instead of just one in this position), and (7) a short, inconspicuous, hairlike seta about 0.3 length of seta *a,* inserted medially on mesal surface. **Clasper.** About basal 0.6 relatively straight, apical 0.4 bent anteriorly at crest, and extreme apex (snout) bent posteriorly; length about 0.6 length of sidepiece; in lateral aspect, width at base about 0.3 length, and width at narrowest point in middle about 0.15 length; crest prominent, densely covered with numerous spicules on outer surface to near apex of clasper; snout elongate, slightly recurved, and apically truncate or rounded; seta *a* strong, length about 2.0 width of clasper at point of insertion, greatest width about 0.2 length, with blunt apex, inserted subapically; seta *b* hairlike, slightly longer than seta *a,* inserted in depression just below crest on lateral surface; seta *c* hairlike, subequal to seta *a,* inserted at same level as seta *b* on inner surface. **Phallosome.** Lateral plate described as it appears in lateral aspect; upper tergal bridge absent; basal hook strongly sclerotized, evenly curved, directed sternad and adhering closely along its entire length to basal hook of other lateral plate; distal portion of lateral plate roughly "T"-shaped; apical tergal process simple, straight, strongly sclerotized, distally tapered to a blunt point, and subequal to greatest width of distal portion of lateral plate; apical sternal process consisting of a strongly sclerotized, apically pointed, laterally directed hook, about 0.5 greatest width of distal portion of lateral plate. **Proctiger.** Paraproct rodlike, with expanded base connected to basolateral sclerotization only by membrane; apex of paraproct slightly enlarged and comblike, with 9-11 flattened, apically rounded teeth; 2 short cercal setae inserted in membrane just below comb, slightly longer than longest comb teeth; cercal sclerite largely membranous; basolateral sclerotization well developed, broadly oval.

**PUPA** (Fig. 2). Abdomen: 3.2 mm. Paddle: 0.7 mm. Trumpet 0.48-0.53 mm; index 4-5. Pigmentation of cephalothorax and abdomen almost colorless to pale golden brown, without distinct pattern of dark and light areas. **Trumpet.** Dark to medium brown; base narrow, 0.4-0.5 width at apex; distal portion more or less cylindrical, tapering slightly to wider apex; pinna small, apical margin truncate; meatus with distanct narrow slit extending from pinna for about 0.1 total length of trumpet. Complete chaetotaxy as figured. **Cephalothorax.** Seta 1-C 3b; 5-C 3,4b; 8-C 5,6b; 9-C 2,3b. **Metanotum.** Seta 10-C 3-5b; 11-C single, longer than 10-C; 12-C single to triple, subequal to 10-C. **Abdomen.** Seta 1-II dendritic, with 6-9 main branches, long, subequal to 3-II; 1-III-VII 5-7b, 5,6b, 2-5b, 2,3b and 2b, respectively; 3-I-III double; 5-IV double, longer than segment following; 5-V usually double (1,2), subequal to 5-IV; 5-VI single or double, shorter than 5-V; 6-III-VI usually double (1-3); 9-VII usually double (1,2); 4-VIII single or double; 9-VIII triple, inserted at caudolateral angle of segment; caudolateral corner of segment VIII rounded. **Paddle.** Broadly oval, unpigmented; midrib weak, slightly pigmented; outer margin smooth; seta 1-P about 0.5 length of 2-P; male genital lobe almost unpigmented to medium brown, strongly conoid and distally tapered to a sharp point.

**LARVA** (Fig. 3). Head: 0.7 mm. Siphon 1.4 mm; index about 7. Anal saddle: 0.3 mm. Complete chaetotaxy as figured. **Head.** Integument almost unpigmented to very pale golden brown; length about 0.65 width, ocular bulge distinct but not large; seta 1-C spiniform, stout, dark; 4-C

single or double, weak, 0.1-0.2 length of 6-C; distance between insertion of setae 4-C 0.65-0.80 of distance between insertion of setae 6-C; 5-C double or triple, 0.45-0.60 length of 6-C; 6-C single, strong, long, apex reaching beyond extended mouthbrush filaments; 7-C 5-7b; 8,9-C 4-6b, weak, short; 10-C 2,3b; 11-C 1,2b; 12-C 4-6b; 13-C 3b; 14-C 2,3b, very small; 16,17-C absent; mental plate with 7,8 lateral teeth on each side of median tooth. **Antenna.** About 0.8 length of head capsule; shaft almost unpigmented to very pale golden brown; shaft below insertion of seta 1-A with scattered, small, fine spicules becoming shorter and thicker distally; 1-A with about 20 strong, plumose branches, apex extending almost to apex of 3-A; 2-4-A bristlelike, dark, subequal; 2,3-A inserted subapically, 4-A inserted apically. **Thorax.** Integument largely covered with scattered, minute, inconspicuous spicules, except on midventral surface. *Prothorax:* Setae 1,2-P single, strong, long; 3-P double or rarely single, weak, about 0.2 length of 1,2-P; 4-P double or rarely single; 5,6-P single; 7-P double; 8-P single or double. *Mesothorax:* Seta 1-M single or double, very small; 2-M 2,3b, subequal to 1-M; 3-M single, moderate; 4-M 2,3b; 8-M 3-5b; 9-M 4,5b. *Metathorax:* Seta 1-T single or double, very small; 2-T 2-4b, about 2.0 length of 1-T; 3-T 3,4b; 7-T 4,5b; 9-T 4-6b; 13-T 5-7b. **Abdomen.** *Segments I-VI:* Spicules absent on anterior segments and very minute on more posterior segments; seta 6-I double; 6-II double or rarely single; 6-III-VI, 7-I all single; 1-III,IV 3-5b; 1-V,VI 2-4b; 13-II,VI multibranched, dendritic, about 0.3 length of segment. *Segment VII:* Minute scattered spicules present; setae 4,7,10,12-VII usually all single. *Segment VIII:* Minute spicules present, aggregated into transverse lines near comb scales, and scattered elsewhere; comb scales numerous (about 60), in dense, roughly triangular patch; individual comb scales about 0.05 mm long (0.02-0.06 mm), elongate, with spatulate apex bearing fine even fringe of spicules; seta 1-VIII 2-4b; 2-VIII single; 3-VIII 7b (6-10); 4-VIII single; 5-VIII 2-4b. **Anal Segment.** Saddle almost unpigmented to very pale golden brown, basal and/or caudal margin may or may not be darker, covered with minute spicules arranged in usually arcuate lines; seta 1-X 2,3b, 0.3-0.4 length of saddle; 2-X with very long, simple main branch and usually 2 short basal branches; 3-X single, subequal to 2-X; 4-X (ventral brush) with 6 pairs of setae, each 4-8b; anal gills about 1.0-1.5 dorsal length of saddle, acuminate, ventral pair longer than dorsal pair. **Siphon.** Almost unpigmented to very pale golden brown, basal margin and acus medium to dark brown; index 6.4-7.2; straight, more or less evenly tapered toward apex, width at apex about 0.6 width at base; moderately long, 3.8-4.4 dorsal length of anal saddle; acus well developed with long dorsal extension, attached; pecten extending from base to 0.23-0.35 length of siphon, and composed of 12-16 teeth; each pecten tooth usually with 2-5 large, widely spaced denticles basally, and smaller, more closely spaced denticles apically; siphonal tufts (1-S) as follows: (1) a subventral row of 5,6 pairs of setae inserted distad of pecten, each seta 3-7b and with length about 1.0-2.0 width of siphon at point of insertion, and (2) 2 pairs of subdorsal setae inserted in apical 0.5 of siphon, each seta usually double (1-3b) and with length less than width of siphon at point of insertion; 2-S simple, curved and apically hooked, with length about 0.6 width of siphon at apex; median caudal filament of spiracular apparatus not apparent.

**SYSTEMATICS.** The topotypic larval specimens collected in Trinidad, 1964-1965, and the *simulator* lectotype larva in the USNM agree very well in general features and chaetotaxy. In addition, the larva of *simulator* can be easily distinguished from all other species of *Melanoconion* from Trinidad known to the junior author. On this basis, we believe that *simulator* and "sp. nr. *jubifer*" are conspecific. Since a number of the larval specimens from Trinidad (TR 355) were individually reared, the association of all stages is certain. Further comparison of the Trinidad specimens with the reared specimens of "sp. nr. *jubifer*" collected in Panama has shown that they are conspecific.

On the basis of common possession of certain characters in the male genitalia, *simulator* is most closely related to *Culex jubifer* Komp and Brown 1935. These characters include: (1) shape of lateral plate, (2) presence of large, fan-shaped, striated leaflet on separate tubercle at base of distal division of subapical lobe, and (3) development of setae on the distal division of the subapical lobe as described above for *simulator*. The first and second characters are found in a few other species of *Melanoconion*, but as far as is known to us, the development of the setae on the distal division is unique; there are other species which have a distal division which appears superficially similar to that of *simulator*, but a detailed comparison will reveal numerous differences. The second

and third characters above are undoubtedly derived, but the first character is probably ancestral since a lateral plate of similar shape is found in species of other New World subgenera of *Culex* such as *Carrollia* and *Micraedes*. Also, the other species of *Melanoconion* which have a lateral plate similar to that of *simulator* ( *ocossa* Dyar and Knab 1919, *vomerifer* Komp 1932, *taeniopus* and *crybda* of Rozeboom and Komp 1950, and others) are believed by the junior author to belong to phylogenetic lines which diverged relatively early from the main phyletic line of the subgenus *Melanoconion*.

*Culex jubifer* can be easily separated from *simulator* in the **male genitalia** by (1) conical shape of sidepiece, (2) distal lateral tergal patch of setae on sidepiece reduced to very small tuft of long setae at base of clasper, and (3) crest of clasper with conspicuous retrorse clump of spicules; in the **pupa** by the much longer trumpet (index about 8); and in the **larva** by (1) much longer siphon (index about 8,9), and (2) abdominal setae 6-III-VI, 7-I double. *Culex jubifer* and *simulator* are at least partially sympatric, since we have seen material of both species from near Pucro in Darien province, Panama (see Heinemann and Belkin 1978:184, 185).

On the basis of the male genitalia, these 2 species (*simulator* and *jubifer*) form a distinct group within the subgenus *Melanoconion*. The relationship of this group to the numerous other species in the subgenus is not evident to us.

**BIONOMICS.** A single adult male (TR 1087) was captured in partial forest, 0800-1500 h, at an elevation of about 50 m in the Arena Forest Reserve in Trinidad. All other adults of *simulator* were reared from immatures.

In Trinidad, the only collection of immatures other than the lectotype (TR 355) was made about 10 km from the type-locality of Arima in a small ground pool in "elfin woodland" at an elevation of about 850 m; the pool was temporary, stagnant, with little vegetation, a mud bottom, and in partial shade.

In Panama, the 4 collections of immatures were all made from small ground pools (3 of them said to be collared peccary water holes) near Pucro, Darien province at elevations of 600 to 1440 m. Two of the collections were made in "marginal cloud forest." The ground pools had clear to dark or muddy water, usually no aquatic vegetation, and were in partial to deep shade.

In Trinidad, *simulator* has been found in association with *Culex (Cux.)* sp. and *Cx. (Mel.) lucifugus* Komp 1936. In Panama, it has been collected in association with *Aedes (Och.) incomptus* Arnell 1976 (holotype), *Anopheles (Ano.) eiseni* Coquillett 1902, *Culex (Mel.) elevator* Dyar and Knab 1906, *Cx. (Mel.) iolambdis* Dyar 1918 and *Psorophora (Jan.)* sp.

**DISTRIBUTION.** In addition to the type-locality (Arima, Trinidad), *simulator* is now known from 2 other localities in Trinidad, and from 2 localities in Darien province, Panama.

**Material Examined:** 190 specimens: 13 males, 15 females, 8 whole pupae, 26 pupal skins, 97 whole larvae, 31 larval skins; 32 individual rearings (23 larval, 3 pupal, 6 incomplete).

TRINIDAD. **St. George:** Arena Forest Reserve, W side of, 50 m, 30 March 1965, A. Guerra, 1 M (TR 1087) (USNM). Mount Chaguaramal (ca. 10 km NE of Arima), near summit of, 850 m, 26 April 1964, R. Manuel, R. Martinez, 4 lpM (TR 355-105,-109,-183,-184), 7 lpF (TR 355-101,-103, -104,-106,-107,-108,-110), 2 L (TR 355) (USNM).

PANAMA. **Darien:** Cerro Mali (mt. ca. 30 km NE of Pucro in Serrania del Darien), 1410 m, 5 June 1963, A. Quinonez, 5 lpM (PA 374-106,-108,-111,-114,-118), 4 lpF (PA 374-110,-112,-116, -119), 3 lP (PA 374-113,-121,-122), 1 M (PA 374), 1 P (PA 374-123), 2 l (PA 374-117,-120), 88 L (PA 374); same locality and collector, 1440 m, 8 June 1963, 1 lpF (PA 379-118), 1 lP (PA 379-160), 1 P (PA 379-161), 2 L (PA 379); same locality and collector, 1440 m, 21 June 1963, 1 lpM (PA 411-105), 1 pM (PA 411-104), 2 pF (PA 411-102,-103), 2 lP (PA 411-101,-106), 5 L (PA 411-1) (USNM). Rio Tacarcuna valley, ca. 600 m, 25 June 1963, A. Quinonez, 1 lpF (PA 423-140) (USNM).

## ACKNOWLEDGMENTS

We thank Dr. Ronald Ward and Dr. John Belkin for reviewing the manuscript, and Vichai Malikul for preparing the illustrations.

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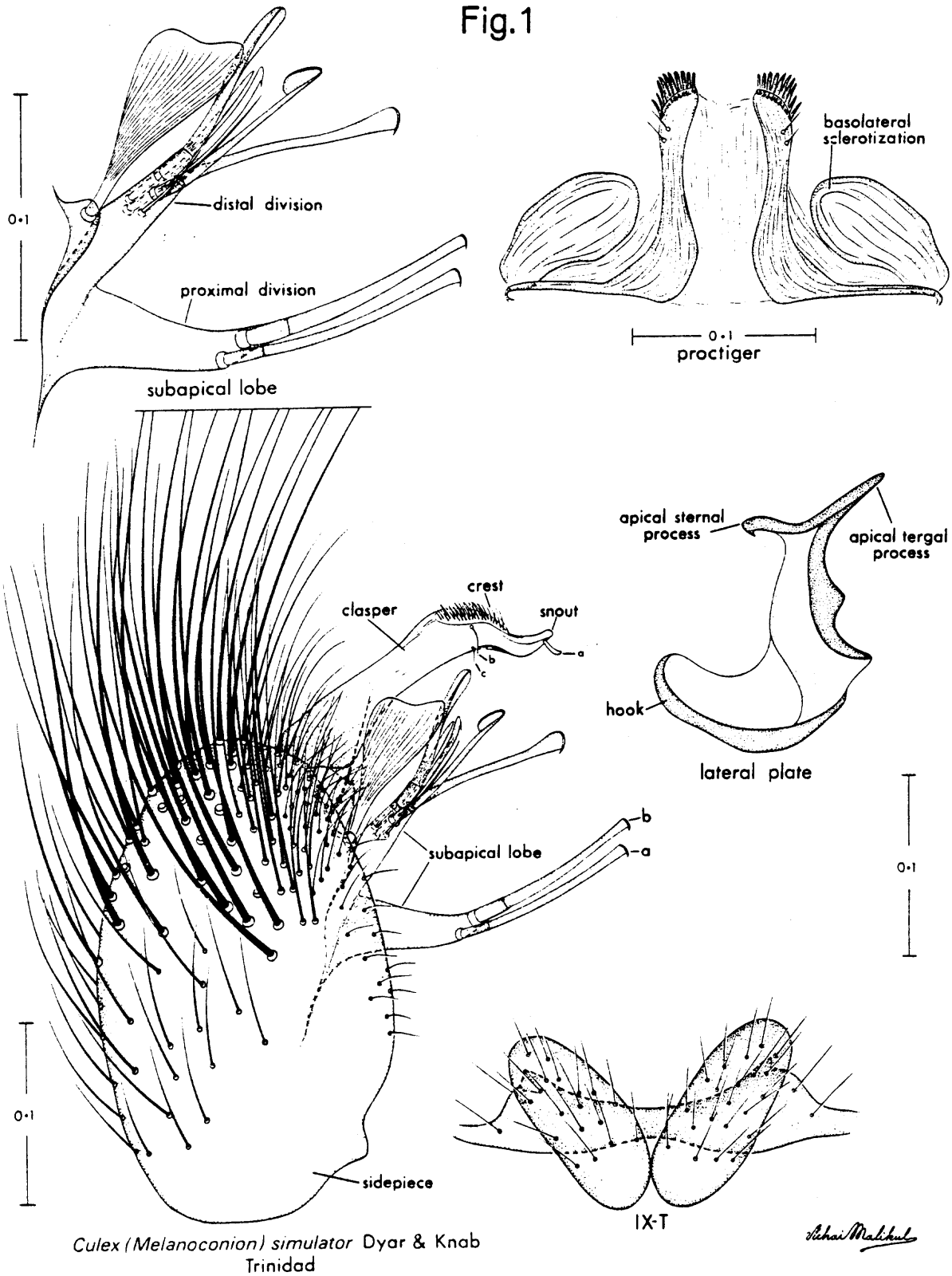
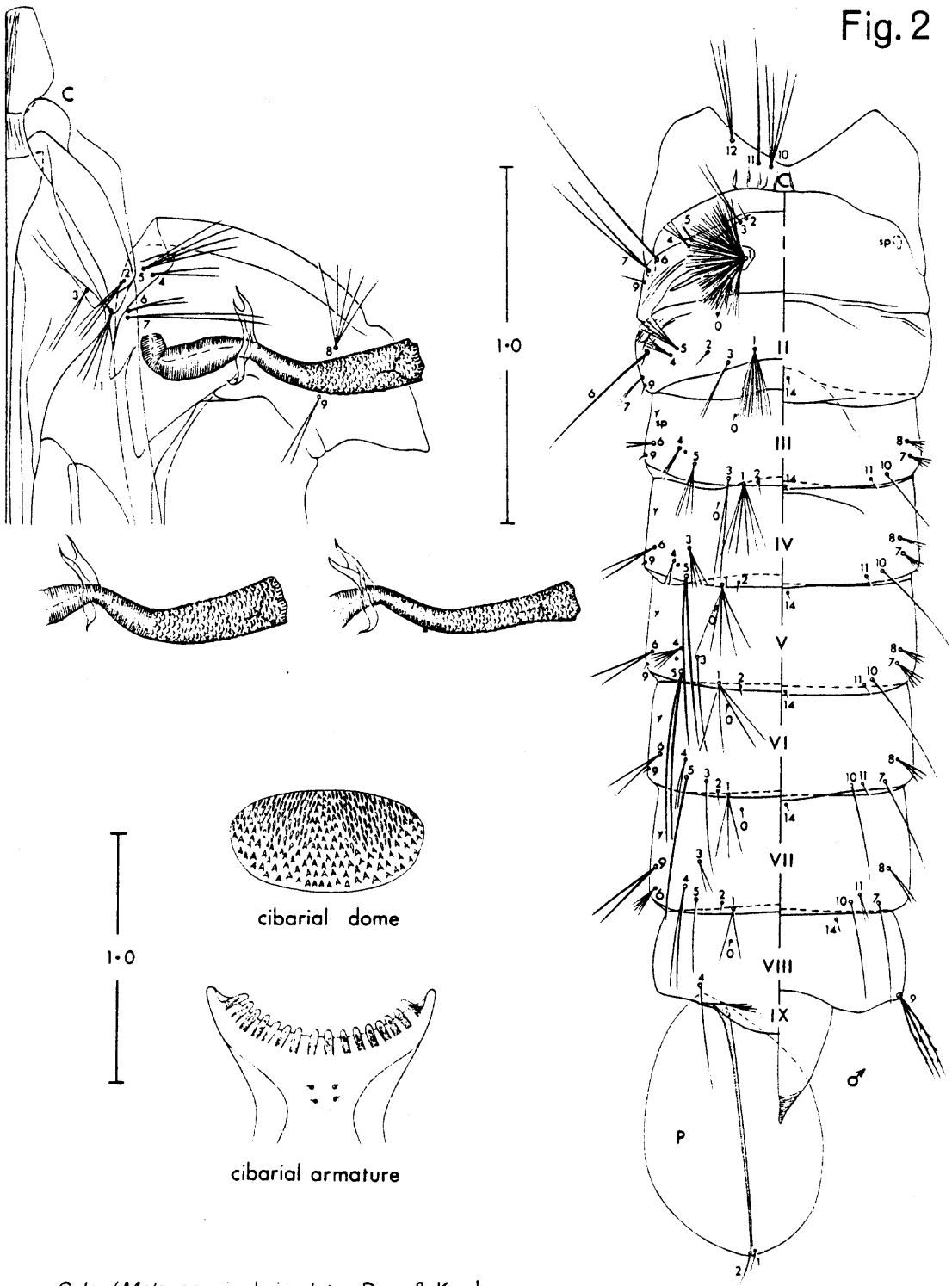
Fig.1




*Culex (Melanoconion) simulator* Dyar & Knab
Trinidad

Fig. 2




*Culex (Melanoconion) simulator* Dyar & Knab
Trinidad

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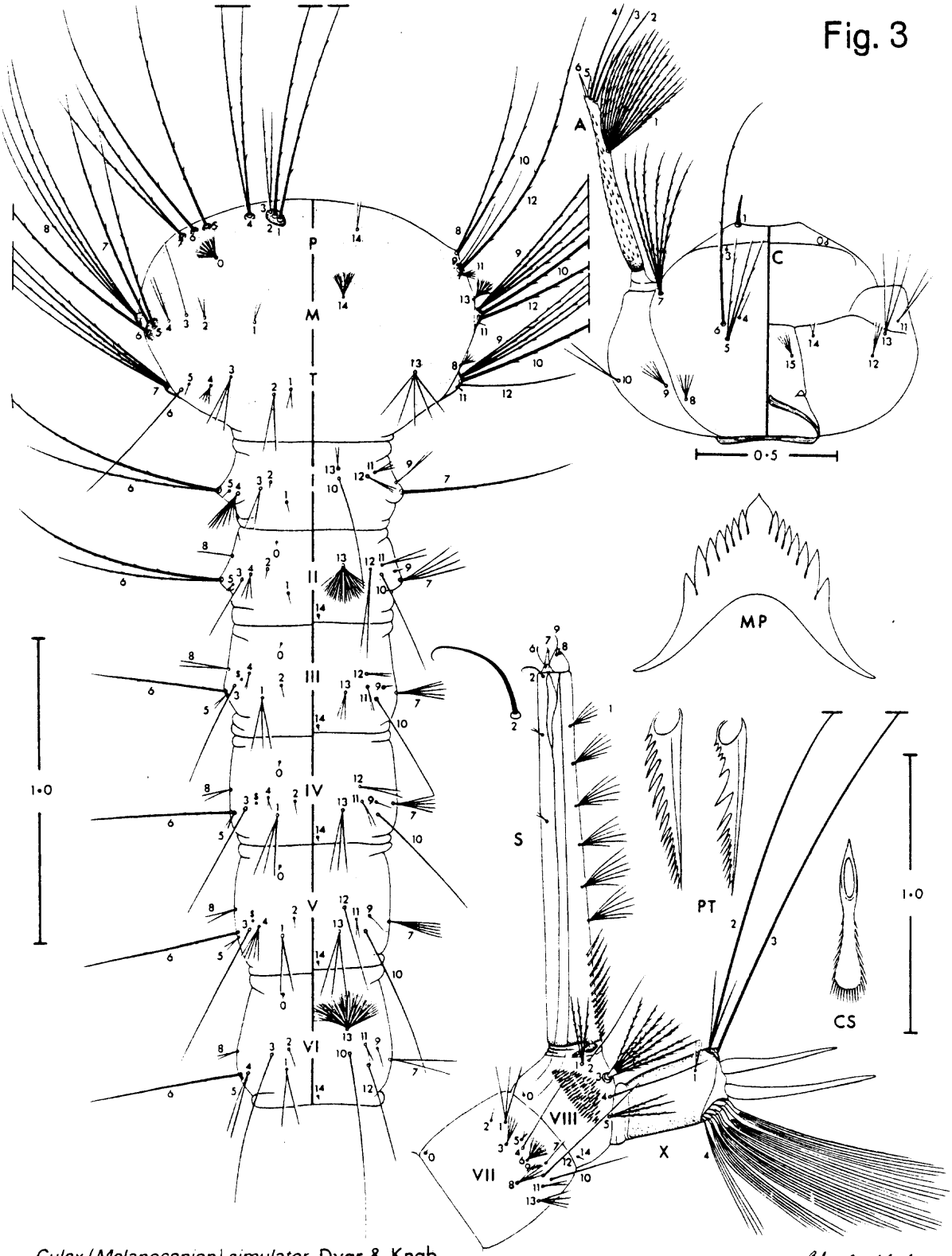
Fig. 3

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